

A REGISTER APPROACH TO ANALOGY IN SCIENCE TEXTS: POPUPLAR VS. SPECIALIZED TEXT TYPES

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Abstract

In this paper, a comparative approach was pursued to show differences but also remarkable similarities between the application of analogy in popular science texts and in specialized science texts. Setting out from an initial hypothesis that popular texts use forms of analogy that lend themselves to direct interpretation and high accessibility, we try to show that actual specialized science discourse could benefit from simpler and more versatile analogy. For this end, the current state of the art in analogy research was evaluated and a corpus of academic texts was queried. Further, a number of approaches and findings could be contributed as a direct outcome of the international *Analogy – Copy – Representation* workshop held at Bielefeld University in November 2014, which was co-organized by the author. In consequence, a more comprehensive picture of analogy in cognition, language and scientific discourse is sketched in this contribution. Especially the domain-dependence of the use of analogies showed surprising results.

Key words

analogy, analogical reasoning, academic English, English for Academic Purposes, corpus linguistics, corpora, genre

1 Introduction

The modern study of analogy begins with Gentner's seminal 1983 paper but of course the phenomenon is in use since ancient times when rhetoric was more relevant than today. It is rooted in the human ability to recognize analogy as a foundational mechanism of human cognition. Itkonen says this very clearly: "Analogy is generally defined as 'structural similarity'" (Itkonen 2005:1) but recognizing this similarity is a higher cognitive function. Extending from this we can state that analogy is defined as the similarity relationship that persists across different domains. Setting out from this similarity, Gentner (2001) uses analogy as the extension of this primary relationship (one aspect of one phenomenon is similar to a second aspect in a second phenomenon) to describe a secondary relationship: If the primary relationship holds, then other aspects of the one phenomenon may be similar to the second phenomenon too. Necessarily, the phenomena are not restricted to visual or linguistic phenomena but also to abstract or logical phenomena as our initial example from the SPACE corpus (sample 0034AX, physics component, to be described in Section 4 shows:

0034AX *There are three main **mechanisms** and respective sites to accelerate particles in the Galaxy: supernova explosions either in the interstellar medium, in young and hot **starbubbles**, or in massive **star winds**.*

The structural similarities in this text from a specialized scientific paper are simple to decode: mechanisms refer to cause-effect machinery in which one module interlocks with another (abstract or logical relationship); star bubbles receive the description from real-life bubbles (soap or else) and star winds combine the structural similarity of a logical phenomenon (directed movement) with a visual one (striations in photographic images).

A systematic study of how these analogies are applied may lead to a more appropriate usage and thus enhanced understanding on the side of the reader although achieving this goal requires a comprehensive survey of different domains.

2 Analogy in science and mind: A brief ‘state of the art’

Analogy-making is a central idea in the cognitive sciences. We may differentiate between two fundamental processes:

- a) the gestalt recognition that goes beyond mere shape recognition (this links up with the non-visual phenomena);
- b) the sequence of re-imagining, translation/transformation and enhancement (cf. Changeux & Connes 1995).

Both processes need to be preceded by a goal or purpose. This purpose is very often inference-making from unknown situations or the modeling/pre-modeling of unknown situations. The envisaged situation is brought in coordination with memorized situations that had one or more aspects in common with the envisaged one. Thus, successful inferencing may ensue on the basis of the similarity. This shows the basic components for successful analogy-making: the necessary consistency of mapping a source on a target due to structural properties. Structural properties of a 1:1 consistency in source and target enable this mapping; a situation or a problem is understood in terms of the components of a different situation or problem.

Further, analogy-making is a central notion in anthropology for structure-building processes in cultures. These processes define culture based on an understanding of nature as imitation and the recognition of oppositions. The mapping of these oppositions onto cultural processes has been termed analogue transfer by Lévi-Strauss (1967). It generates all relevant cultural categories, as in spatial extensions and ethno-methodological ontologies.

In linguistics, analogy-making is the basis for conceptual metaphor theory (CMT) by Lakoff and Johnson (1980) and its derivatives like conceptual blending (Fauconnier & Turner 2002). Thus, analogy is at the heart of cognitive linguistics, for strategies of categorization in vertical system (Evans & Green 2006) or radial systems (Wierzbicka 2006).

In other humanities, analogy-making is a reflective and analytic principle of creation as in the visual arts or with the leitmotif technique in music.

2.1 Analogy as a cognitive phenomenon

Analogy-making is pervasive in cognitive action. Fauconnier (1997: 20) summarizes this as follows:

Analogical mapping is so commonplace that we take it for granted. But it is one of the great mysteries of cognition. Given the richness of the domains and their complexity, how are the right schemas consistently extracted, elaborated, and applied to further mappings? And what are these schemas and generic frames that structure our conceptual systems so pervasively?

Gentner (2001: 17) isolates three plausible subordinated processes:

- a) the mapping of representative structures of base situations onto target situations (structural alignment);
- b) the projection of inferences;
- c) the evaluation.

All three processes can be illustrated with corpus examples:

- a) 0064NS *But Cooke says that in another round of experiments they fed the mice amounts of genistein equivalent to those given to babies in soya formula.*

The base situation of soya formula milk given to babies is mapped onto the target situation, genistein fed to mice.

- b) 0052NS *Elderly rats have rediscovered their youth by eating two simple dietary supplements sold in healthfood shops. If the regime works in humans, it could make for a sprightly old age.*

The inference originates in the rejuvenation of elderly rats. Applied to humans the rationale is that it may work for them too.

- c) 0009NS *The team modelled the Universe as an entity with four dimensions of space and time called a “brane”, embedded in a background space with five or more dimensions. We perceive only the four dimensions, just as people in earlier times thought the Earth was flat instead of a 3D sphere.*

Here, the reader is led to follow the evaluation of the author (together with the scientists) that the difference between 5 dimensional space and our 4D-perception corresponds with the assumption of 3D-perception on a 2D-Earth.

The most influential theory to emerge from this is Gentner's structural alignment theory (1983). Here, a familiar situation (the base) is used as a template for inductive reasoning in a target situation. Single elements of the base situation are recognized as parallel or similar to elements of the target. Further, relations between base elements are mapped onto relations between elements of the target. This generates a set of candidate inferences (cf. Gentner 2001) which are constrained only by limitations of general order (like world knowledge, natural laws if applicable, causality, etc.). Gentner formulates as a requirement the structural well-formedness, factual validity and relevance for the target (ibid: 17).

An alternative theory is Holyoak and Thagard's goal-oriented theory (1989). It emphasizes the primacy of the goal and puts analogies into the role of a tool to reach said goals. The direction of the analogy-making can be towards the target (called projection-first modeling) but also retrograde from the target to a model of the base (and both are compared afterwards). The resulting model is a desired outcome of the inferencing but it can also emerge incrementally from the mapping function itself (alignment-first modeling, cf. Hofstadter 1994). Especially the latter theory is more relevant in general problem solving because the structural well-formedness very often plays a second role to pragmatic constraints. In scientific analogy-making these constraints are especially viable and important (cf. Section 4). Thus, in conclusion, analogy-making in cognition is mainly goal-oriented as this also offers evolutionary incentives.

2.2 Analogy as a device in scientific discourse

Analogy in scientific discourse needs entrenchment from the related terms of homology and anomaly. Homology (from Greek for 'correspondence') is used in biology to denote organs that show fundamental similarities across species boundaries and over long periods of time. A classic example is the larynx of humans and chimpanzees which has the same physiological function and looks very similar. However, humans have a lowered larynx and it is this detail that enables vocal speech. The chimp homology is a conduit for air and food and not much else. The wings of birds and insects may serve as a counter-example. They are analogs but no homologies as they have the same or a similar function (flying, hovering in midair) but they have no evolutionary correspondence.

A similar pairing of form and function comes from the distinction between analogy and anomaly. Aristotle (an analogician) sees for instance language as a set of forms with an inner order. Ancient anomalists did not deny the function

of language but they saw their gestalt as chaotic. Even though the analogue approach enables the definition of categories, the discussion itself is still viral, for example in typology (cf. Aarts 2007).

The sciences have a long and uninterrupted history of using analogy-making as a tool for understanding (cf. Table 1) but also for outreach in science education (cf. Section 2.3).

A short summary can be found in Harrison and Treagust (2006):

Maxwell used water pressure in tubes to mathematically describe Faraday's electric lines of force
Robert Boyle imagined elastic gas particles as moving coiled springs
Huygens used water waves to theorise that light was wavelike
Konrad Lorenz used analogy to explain streamlined motion both in birds and fish
Kekulé derived his idea for a benzene ring from an image of a snake biting its tail

Table 1: Scientific discovery and analogical thinking (adapted from Harrison & Treagust 2006: 15)

Thus, “[A]nalogy and metaphor are central to scientific thought” (Gentner & Jeziorski 1993: 447) even though the examples in Table 1 may seem overly simplistic. Incidentally, Gentner returns in almost all treatments on analogy to the example of Rutherford’s analogy of his atomic model to a miniature solar system. While this has been an influential device in the early phases of modern physics (the early 20th century) when it replaced Thompsons’s ‘plum pudding’ model – the electrons are embedded in a positively charged mass (Hawley & Holcomb 2005: 87), today other and very persistent analogies are perpetuated. This may be illustrated with the relatively recent theory of an inflationary phase after the big bang. The expansion of the primordial universe has almost unequivocally been likened to the expansion of a balloon on which spots have been painted. As the balloon inflates, all spots move away from each other but not away from a common center. This analog is even used in academic books on cosmology (cf. *ibid*: 299-300). Readers are usually asked to take this analog one dimension higher and the spots on the balloon surface are the galaxies in the observable universe, all moving away from each other. This also explains why the universe does not have a center and the analogy tries to steer the popular reader away from the common misconception of the big bang as an explosion.

The image of the big bang as a cosmic explosion ejecting the material contents of the universe like shrapnel from an exploding bomb is a useful one to bear in mind, but it is a little misleading. When a bomb explodes, it does so at a particular location *in space* and at a particular moment *in time*. ... In the big bang there is no surrounding space. (Greene 2003: 83; italics in the original)

However, the picture gets more complicated with the inflationary model of the universe to which first empirical evidence was found as this paper was conceived (March-April 2014). The new model requires to think of a “balloon producing balloons producing balloons” (in a conversation with the eminent cosmologist Linde; cf. <http://edge.org/conversation/a-balloon-producing-balloons-producing-balloons-a-big-fractal->).

The systematicity of the old analog is therefore extended but the base for it uses the target (the balloon) of the old model. We can speak of hierarchically structured analogs (cf. Wilson et al. 2001: 125).

2.3 Analogy as a pedagogical tool (also in the sciences)

The change of analogy as a pedagogical tool is reflected in the change of the state of knowledge of the natural phenomena that are described by them. This is what Gentner (2002) calls an “ontological change”, illustrated with the following table of a pre-Keplerian and a post-Keplerian model of the solar system:

BEFORE	AFTER
Planetary system is governed by mathematical laws	Planetary system is governed by physical causality
Planets’ orbits are crystalline spheres containing planets or eternal circles traveled by planetary intelligences	Planets’ orbits are paths continually negotiated between the Sun and the planets
... Planetary paths are perfect circles of uniform speed	... Planetary paths are ellipses, faster when closer to the Sun and slower when further from the Sun
Anima motrix as “spirit” in Sun that moves planets	Vis motrix as “force” from Sun that moves planets

Table 2: Conceptual change (adapted from Gentner 2002: 27)

While a few of the examples in Gentner’s table walk the fine line between metaphor and analogy (‘orbits are spheres’), there is a marked didactic difference between metaphor and analogy. In the sciences, metaphor is predominantly used for commitment. Metaphor enables entailments that suggest a new range of ideas, also by expressing an abstract idea in familiar terms (Aubusson et al. 2006: 2-4).

3 The linguistics of analogy

3.1 Overview

Analogy in the description of linguistic phenomena has an implicit problem due to the fact that it has been used generously to cover a wide area of relationships. In this section, the main approaches are classified and in the last step focused on the corpus study.

The first bridge between cognitive behavior and language is the acquisition of analogy. In first language acquisition, analogy is defined as the “process that allows children to produce new grammatical forms by generalizing the structure of forms they already know” (Bornstein & Lamb 2011: 441).

The approach that has achieved a somewhat dominant status in linguistic analogy research is connected with the terms ‘proportional analogy’ and ‘analogical leveling’. In simple terms, a is to b what c is to d (a:b :: c:d). This can be demonstrated on the systematic changes in English plural formation. The regular plural -s stands in opposition to only very few irregular forms (*focus/foci*, *child/children*, etc.). However, in first and second language acquisition, learners make forms that are irregular to the regular paradigm (like *child/childs*). Further, this can also be observed in historical processes. For example the irregular *cou/kine* was abandoned and regularized first to *cou/cows*, then to *cow/cows*. (Credits for this and the following example go to Marion Schulte of Bielefeld University). On the other hand, the extension of an irregular paradigm is rare but there is a small number of examples. For example the pattern *drive/drove* is mapped onto the regular *dive/dived* which as a consequence becomes *dive/dove* in some varieties of English (Blevins & Blevins 2010: 6). This latter type of ‘morphology by analog’ seems according to Hay and Baayen (2002) not qualitatively different to regular paradigms. Further, this argument is used in generative approaches to reject the power of analogy in linguistics. But it was especially in morphology where at an early stage the descriptive rules were little more than very general applications of analogy, cf. Bauer: “[I]t could be that speakers work with analogy, but that linguists’ descriptions of the output of this behavior are in terms of rules. It may also be that rule systems presuppose analogy: they must start somewhere” (2001: 97). However, the simplicity of this approach (also favored by standard treatments of word formation like Plag (2003) is somewhat attacked by Hock (2005) and others who see little systematicity in word formation processes like clipping and blending (Hock 2005). Thus, at this pivotal point in morphology, the debate seems at an impasse. Summarized here in a nutshell as:

- a) morphological rule application is analogy-making; vs.
- b) morphological rule application and analogy-making are independent processes.

The proponents of b) have a strong point in asking, why is analogy-making so unpredictable? Plag (2003: 38) summarizes: “[I]t is unclear why certain analogies are often made while others are never made. In a rule-based system this follows from the rule itself”. The proponents of a), however, may interject that the rule must come from somewhere.

3.2 Analogy and metaphor and analogical modeling

While analogy and metaphor are often treated as two sides of the same coin, there are marked differences not only in its linguistic representations but also in its conceptual origin. While a metaphor (in the sense that ‘A is said to be B’) (Aubusson et al. 2006: 2), an analogy like ‘particles are ping-pong balls’ would claim ‘A is like B’. Thus, the first comparison can be considered covert, the second clearly is overt (ibid.).

Analogical modeling (AM in the literature) assumes a peculiar position among the linguistic and psychological theories of categorization. While in each branch at least two opposing camps exist (in linguistics: symbolic-rule systems in the Pinker tradition vs. connectionist models in the Rumelhart tradition; in psychology: prototype models in the Rosch tradition vs. exemplar-based approaches, cf. Chandler 2002: 52-53), AM sets out from the exemplar-based mindset.

4 Analogy in the SPACE corpus

4.1 Data set, methodology, expectations

The SPACE corpus (an acronym for corpus of Specialized and Popular ACademic English) has been described extensively elsewhere, for example in this journal (Haase 2010). The two main components comprise specialized discourse (taken from original publications) and popularized versions of these research papers (from a popular-science magazine). The domains are physics (quantum physics, particle physics, cosmology) and the biosciences (biochemistry, genetics, microbiology).

The methodology employed in a study of this kind is a departure from classical corpus studies in the sense that it combines quantitative with qualitative methods. In a first step, a subset of texts was extracted from the corpus that represents a sample of comparable quantity (word length) in the considered domains. This procedure is owed to the fact that analogy is notoriously hard

to connect to frequently repeating word classes or collocations. Even though the SPACE corpus is POS-tagged (with the Treetagger tagset), no automatic procedure exists to extract analogs. The sample was kept rigidly parallel so that analogies in specialized and in popular discourse could be compared. In a final quantitative step, the source and target domains of the analogies were measured according to their semantic complexity. This was carried out using the ComplexAna tool in the 2.0 (2014) version. The most current description of ComplexAna is Haase (2013).

The following two tables summarize the subset used for this study. Table 3 displays the two text types in parallel.

domain	text type: specialized- academic	code	Words	text type: popular- academic	code	words
physics/quant	Experimental realization of quantum games on a quantum computer	0005AX	3,315	Multiple choice	0005NS	2,331
physics/cosmol	Experimental hints of Gravity in Large Extra Dimensions?	0007AX	1,833	Pulling power	0007NS	1,687
physics/cosmol	Implications of Gauge Unification for Time Variation of the Fine Structure Constant	0013AX	5,277	Blinding flash	0013NS	2,026
physics/cosmol	The Ultimate Fate of Life in an Accelerating Universe	0023AX	4,282	Never say die	0023NS	2,265
physics/cosmol	Kinematical solution of the UHE-cosmic-ray puzzle without a preferred class of inertial observers	0027AX	6,229	After Einstein	0027NS	2,603
total			20,936			10,912

Table 3: Subset from the physics component of the SPACE corpus

As can be seen, a subset of only ten texts was selected for which the length ratio would be more balanced than with most pairings in the corpus.

domain	text type: specialized- academic	Code	words	text type: popular- academic	code	words
biosc/ biochem	Crystal structure of oxygen-evolving photosystem Ii from <i>Thermosynechococcus vulcanus</i> at 3.7-Å resolution	0047PN	5,758	Flower power	0047NS	2,269
biosc/ zoo	Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses	0056PN	4,721	Thought of food	0056NS	3,279
biosc/ microbio	Biosilica formation in diatoms: Characterization of native silaffin-2 and its role in silica morphogenesis	0069PN	5,010	Natural glass	0069NS	2,379
biosc/ palaeo	The anthropoid status of a primate from the late middle Eocene Pondaung Formation (Central Myanmar): Tarsal evidence	0070PN	4,811	Out of asia	0070NS	2,523
biosc/ microbio	Electrical cues regulate the orientation and frequency of cell division and the rate of wound healing in vivo	0071PN	5,384	The body electric	0071NS	2,514
total			25,684			12,964

Table 4: Subset from the biosciences component of the SPACE corpus

The initial assumption about the data is that popular texts use more directly accessible analogs to facilitate understanding of the in most cases abstract (in the case of the physics texts, highly abstract) phenomena observed in the original research. Further, the number of expected analogies is higher in the popular texts. As these texts are generally shorter, the use of analogy should be structure-building tool in popular texts but would only have the role of a facilitator in the specialized texts.

4.2 Data discussion

In the texts the relevant analogies were identified and collected. Not counted were ‘default’ analogies like bottleneck, symmetry break, soft parameter, string, spacetime-foam, agricultural runoff, etc. The length of the subcorpus was balanced to provide a matching popular/specialized ratio. Since all specialized texts are longer than their popular counterparts, the number of identified analogies

needs to be calculated in proportion. The popular/specialized ratio concerning text length for physics is 0.51; the ratio for the biosciences is 0.5. The selection of texts was random but with a balanced ratio in mind because the figures are different when the entire corpus is concerned, cf. Table 5:

Component	mean text length	ratio
specialized-academic physics – sample	4,187	0.51
popular-academic physics – sample	2,182	
specialized-academic biosciences – sample	5,137	0.5
popular-academic biosciences – sample	2,593	
specialized-academic physics – total	4767	0.15
popular-academic physics – total	698	
specialized-academic biosciences – total	4,749	0.11
popular-academic biosciences – total	515	

Table 5: Comparison of the length and [popular :: specialized] ratios in the sample and in the entire corpus

Obviously, in the overall corpus the popular papers are much shorter which explains also the drastic differences in the ratios. As for the quantification of analogies, the longer popular texts provided thus a better means of comparison.

A number of cases will be discussed in the following.

Analogy in physics texts

The use of analogy in physics texts is at first glance obvious as mostly phenomena are described that are not accessible to human perception either because they extend to large-scale structures (in cosmology) or to small-scale structures (as in quantum physics). Surprisingly, the analogies in the specialized text seem relatively conventionalized and uncreative:

0005AX *quantum Prisoner's Dilemma / this quantum **game** / The two **thresholds** are analogous to phase transitions. When the amount of entanglement is less than the **smaller threshold**, one is in a **classical region**. When the amount of entanglement lies **between the two thresholds**, one is in a **transition region** between classical and quantum behavior. The last domain is the fully **quantum region**.*

The text explicitly states its main analogy at the outset (a quantum effect is related to the prisoner's dilemma), thresholds are analogous to phase transitions. In another example, temperature of inhuman scales is equated to human dimensions:

0013AX *The **freeze-out temperature** $TF \sim 0.72 \text{ MeV}$ is set roughly by equating the weak interaction rate at temperature T to the universe's expansion rate.*

The last example is more interesting as the analogy is more systematic and in fact inherent to the model:

0023AX *Any lifeform would eventually **fry to death** in the **bath of thermal Hawking radiation** produced by the de Sitter vacuum Beings of any kind generate heat by the process of living / and eventually are unable to dissipate their heat in the background of this **thermal bath**. / The **creature must be able to get rid of the heat E** generated by the computations it performs (4). / The **creature will fry to death** unless it can dissipate the heat E that it creates; / yet continue to radiate waste heat into space during its **periods of hibernation**. The society can remain active for a fraction $g(t)$ of its time **while hibernating** for the remaining $1 - g(t)$ fraction of the time.*

The lead analogy goes back to a classic suggestion to equate life with the ability to perform computations; however, computations consume energy. This gives rise to a cascade of analogies in which life is equated with the computing 'creature' who will either fry in a thermal bath or hibernate.

The observations for the popular texts are quite different. While some of the original analogies are preserved as they are integral to the understanding, further layering occurs, as in:

0005NS ***Spice up** game theory **with a dash** of quantum mechanics / game called the Prisoners' Dilemma. / their **qubits pointing down**, representing their supposed solidarity / the **jailers** measure the state of the qubits. / mathematical **elbow grease***

Further, visual analogies as they also appear in specialized texts, (cf. 0034AX in Section 1) are extended with tactile ones:

0007NS *interstellar **cloud** of gas, / **sprinkled** with dust grains / Jupiter is responsible for **sweeping up** most of the Solar System's **rogue comets** / that **interstellar grains** grow into **fluffy, snowflake-like structures** / growing aggregates were **much fluffier** than expected-more like **wiggly fractal strings**, or "**seedlings**", /extremities of the **growing fluff***

The core analogy of 0023AX is actually explained in detail:

0023NS *thought must be like computation / In Dyson's definition, a hibernating organism essentially stops its metabolism entirely, which means it must stop thinking/ It's hardly a **balmy glow**: working from what the supernova data reveals, it'll be something of the order of 10-29 kelvin.*

The overall tendency in the physics texts is that most popular texts rely on one guiding analogy and follow it through, changing it on the way sometimes

for stylistic effect. The specialized texts establish more straightforward structure mappings that are often sporadic.

Analogy in the biosciences texts

The main surprise in this study is the abject lack of analogy-making in the specialized bioscience texts. One assumption about this is the apparent concreteness of the processes (which are mainly narrated to a level of detail not present in the physics texts). Their difficulty and almost impenetrable quality for laypersons is not alleviated by analogy as the phenomena are not abstract, though they are highly specialized. In the popular versions, the physics trend can be observed as well; often one master analogy is carried through the entire text. This can be observed well in the following example:

0047NS ***splitting*** of water molecules into oxygen, hydrogen ions and electrons.
This is the ***heartbeat*** of photosynthesis, / the energy required to ***dismember water***
/ the plant's ***photosynthetic machinery*** / chlorophylls that ***sit cheek-by-jowl*** inside
the chloroplast / the catalytic core ***dismembered the water molecules*** bit by bit,
/ The catalytic core then ***clicks through*** the fourth step of the cycle / point the
system grinds to a halt,

Here the target process of photosynthesis is clearly mapped onto machine analog bases. The text makes no secret of it ('the plant's photosynthetic machinery').

In the last step of the study, the analogies were subjected to a profiling of semantic complexity. The scores obtained by this (a higher score indicates a greater complexity as calculated by the position of the nominal base analogs in Wordnet) can then be compared and related to the text type.

	mean score analogies	mean score sample	mean score text type
specialized-academic physics	19.4	24	23.61
popular-academic physics	21.12	19.7	19.11
specialized-academic biosciences	n/a	27.7	26.28
popular-academic biosciences	19.94	20.04	19.79

Table 6: Semantic complexities for analogies, sample texts and SPACE (total)

The results from the software algorithm show clearly the simplifying role of analogy-making. In the specialized physics texts, the analogs score only 19.4, the lowest score of all compared text types. Due to their sporadic nature they probably need to be simpler than the elaborate and abundant analogies in the

popular texts. In fact, the analogies in the popular texts have a higher score than their surrounding text (21.12 vs. 19.7). Notoriously high are the scores for the texts in the biosciences. Here, abstraction is replaced by extremely complex terminology.

5 Conclusion

This contribution has attempted to show that the use and application of analogy show marked differences in different genres of academic discourse. The initial assumption of analogs structuring scientific thinking (for which there is abundant evidence from the natural sciences as well as from the cognitive sciences which set out to study this correspondence) can be manifestly said only for popular depictions of science. Analogy-making is in fact undeveloped in academic texts in the biosciences and relatively erratic in physics. However, all popular text types show interesting and creative variation that elevates their semantic complexity even over the texts in which they appear. A caveat, however, may be that the disappointing yield for the biosciences is due to the small sample.

Endnote

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